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STATUS OF THE ATLANTIC SALMON STOCK ON FORTEAU RIVER, 1994

by

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ABSTRACT

This is the first assessment of the status of Atlantic salmon stocks on the Forteau River which is the second largest of the three scheduled salmon rivers in southern Labrador, Salmon Fishing Area (SFA) 14(B). In 1994, a counting fence was installed on the Forteau River at the mouth of First Pond. Returns to the counting fence and catches in the recreational fishery indicated that Forteau River had a returning population of 535 large and small Atlantic salmon in 1994. Preliminary target spawning requirements were derived for Forteau River on the basis of the accessible rearing habitat described by Anderson (1985) from the tributaries which were visible on 1:250,000 scale topographic maps and the habitat accessible on additional tributaries which were visible on 1:50,000 scale topographic maps (SPANS GIS). The potential egg deposition by Atlantic salmon on the Forteau River in 1994 was 62-96% of the preliminary target spawning requirement. These values were above estimates for 1990-1992, but below the percentage of targets achieved in most years prior to 1990. Recreational and commercial catches of salmon in 1994 supports the conclusion of relatively low abundance compared to previous years. The recreational catch of small salmon on Forteau River in 1994 was above the 1992-1993 mean but below the 1978-1983 and 1984-1991 means. Recreational effort in 1994 was above the 1978-1983, 1984-1991 and 1992-1993 means but CPUE was below the 1978-1983, 1984-1991 and 1992-1993 means. The commercial salmon fishery in SFA 14(B) landed only 5.4t of the 8.0t quota in 1994.

RÉSUMÉ

On trouvera ci-après la première évaluation des stocks de saumon de l'Atlantique pour la rivière Forteau, qui est, en importance, la deuxième des trois rivières réglementées de la zone de pêche du saumon (ZPS) 14(B), dans le sud du Labrador. En 1994, une barrière de dénombrement avait été installée dans cette rivière, à l'embouchure de l'étang First. Les montaisons jusqu'à cette barrière et les prises des pêcheurs sportifs révélaient que la population de grands et de petits saumons revenus dans la rivière en 1994 s'établissait à 535. Les besoins-cibles de reproducteurs ont été établis de façon préliminaire en fonction de l'habitat d'élevage accessible décrit par Anderson (1985) d'après les tributaires visibles sur des cartes topographiques à l'échelle 1/250 000 et d'après les autres tributaires visibles sur des cartes topographiques à l'échelle 1/50 000 (SIG SPANS). La ponte potentielle des saumons de l'Atlantique dans la rivière Forteau en 1994 se chiffrait à 62-96 % de la cible préliminaire. Ces pourcentages étaient supérieurs aux estimations de 1990-1992, mais inférieurs aux pourcentages obtenus dans la plupart des années antérieures à 1990. Les prises sportives et commerciales de saumon de 1994 confirment que l'abondance est relativement faible par rapport aux années antérieures. Les prises sportives de petits saumons dans la Forteau en 1994 étaient supérieures à la moyenne de 1992-1993, mais inférieures à celles de 1978-1983 et de 1984-1991. L'effort des pêcheurs sportifs en 1994 a été supérieur aux moyennes de 1978-1983, 1984-1991 et 1992-1993, mais les PUE étaient inférieures au moyennes de ces trois périodes. Les pêcheurs commerciaux de saumon de la ZPS 14(B) n'ont débarqué que 5,4 t de saumon, sur un quota de 8 t, en 1994.

INTRODUCTION

The Forteau River is one of the three schedule salmon rivers in the Salmon Fishing Area (SFA) 14(B) (Figure 1). The Forteau River flows into Forteau Bay (Figure 2), in the Strait of Belle Isle at latitude 59° 29' N and longitude 56° 58' W. The Forteau River has a drainage area of 389 km^2, it drains from a barren plateau with a basin relief of 336 m and has the total axial length (including tributaries) of 198 km (Anderson 1985).

The Forteau River has supported a recreational salmon fishery at least since 1954, when angling catch and effort statistics were first recorded (Table 1), and has supported guiding and outfitting operations since the 1960s. Currently, many anglers are attracted to southern Labrador rivers primarily for the opportunity to retain large salmon which has been prohibited on the island of Newfoundland since 1984. The angling effort on the Forteau River has shown an overall increase since 1954 (Figure 3). However, the catch, particularly of large salmon, has declined since 1970 (Figure 3). The low catch-per-unit-effort (CPUE) in recent years combined with the decline in the percentage of large salmon angled (Table 1) has resulted in a great deal of concern for the status of the Forteau River salmon stock among local anglers and interest groups.

Similar concern has been expressed over the status of salmon stocks in SFA 14(B) in general (Mullins and Jones 1992). Recreational catches of small and large salmon and CPUE on the Pinware River which produces about 68% of the small salmon and 90% of the large salmon recreational catches in SFA 14(B) (Table 2) have also declined compared to historical levels (Table 2).

A recreational fishery quota of 1,100 small and large salmon was imposed on southern Labrador rivers in 1992 to help conserve the stocks (Mullins and Jones 1993) (Table 3). The quota was increased to 1,400 fish in 1993, but the seasonal and daily bag limits were reduced (Mullins and Caines 1994). The quota was removed in 1994 but the seasonal bag limit was reduced from eight small and large salmon in 1992-1993 to six in 1994. The daily bag limit increased from one in 1993 to two salmon per day in 1994. The number of large salmon (> = 63 cm) allowed to be retained was reduced from four in 1993, to only two per license in 1994.

Several major management changes were also implemented in the Newfoundland and Labrador commercial salmon fisheries in recent years which appeared to result in some improvements in the status of SFA 14(B) stocks, particularly for large salmon (Mullins and Caines 1994; Mullins and Jones 1993). The number of licensed fishermen was reduced from 54 in 1992 to 13 in 1994, and the commercial salmon quota which was introduced in SFA 14 in 1990 (60t) was reduced to 15t for SFA 14(B) in 1992 and then to 8t in 1993 and 1994 (Table 3). The Northern Cod moratorium introduced in 1992 and the closure of the cod fishery in NAFO area 4R in 1993 should also have helped reduce the fishing mortality on SFA 14(B) stocks by eliminating the by-catch of southern Labrador origin salmon in SFAs 1&2 and SFA 14(A).

This document represents the first assessment of the status of the Atlantic salmon stock on the Forteau River and is the first individual river assessment in southern Labrador, SFA 14(B). The status of the salmon stock on Forteau River in 1994 is assessed relative to the preliminary target spawning requirements developed for the river based on estimated available rearing habitat and in comparison to estimates of salmon abundance in 1975-1993.

MATERIALS AND METHODS

Recreational Fishery

Weekly salmon angling reports were completed by the Department of Fisheries and Oceans (DFO) river guardians and fishery officers for the entire angling season in 1994. The angling statistics in southern Labrador rivers, as in previous years, included the catches and effort of local angling camps. Water levels, observed and estimated rod-days of effort, and observed and estimated numbers of small and large salmon retained and released are recorded on a daily basis. One rod-day is the fishing effort expended by one angler during all or part of one day; two or more fishing periods by the same angler of the same day are counted as one rod-day. The observed data represent actual observations by the River Guardians or Fisheries Officers and those reported to them by others (mostly through conversations with anglers). Estimated data represent effort and catches for days when the river was not patrolled or while patrolling other areas. These estimates were based on the individual's knowledge of the migratory pattern of the salmon stock, local weather conditions, water levels, and patterns of local angling effort.

Salmon catches in the recreational fishery were categorized into small and large size groups. The criteria for small and large salmon designations are as follows:

Small (grilse) - < 63 cm fork length
Large - >= 63 cm fork length

The timing of the recreational catches of small and large salmon were based on summaries by standardized weeks (Table 4).

Returns of Atlantic salmon to the Forteau River

A counting fence (Anderson and MacDonald 1978) and steel-frame-trap was installed on the Forteau River near the outflow of First Pond (Figure 2). The counting fence was installed and operated from 25 June until 3 October 1994. Due to the low attraction flow through the counting trap, on 7 July the fence and trap were relocated about 30 m downstream from the original location. On 23 July, a video counting system was installed next to the counting trap in order to improve the upward passage of fish. This system consisted of a stationary underwater camera

(enclosed in a waterproof casing), placed in a wooden channel at an opening in the counting fence. Salmon passing upstream through the channel were recorded on VHS tapes which were later reviewed for enumeration. The video counting system allowed for barrier-free upstream migration. The total returns to the river were determined based on enumerations at the counting fence and the number of salmon angled below the counting fence.

The counting fence was checked daily at 0800, 1200, 1600, and 2000 hours. All species captured were identified, enumerated and released. Salmon were classed as small or large using a 63 cm fluorescent orange stick resting in the bottom of the counting trap. Salmon recorded by the camera system were not measured. Air and water temperatures (C) and water level (cm) were recorded during each trap check.

Biological characteristics of the Forteau River Atlantic salmon

Biological characteristics of salmon on the Forteau River were obtained from fish landed in the recreational fishery in 1975-1994. These were sampled for fork length to the nearest 0.1 cm, whole weight to the nearest 0.1 kg and sex determination by internal examination. Scale samples were obtained for age determination from the left side of the salmon in an area above the lateral line and in line from the posterior edge of the dorsal fin to the anterior edge of the anal fin. Approximately 10-15 scales were collected. The river-age, sea-age and evidence of previous spawning were determined according to the method described by Anonymous (1984). Salmon that passed through the counting fence in 1994 were not sampled.

Estimation of Angling Exploitation Rate

The distribution of recreational catches and effort on the Forteau River appeared to be influenced by the presence of the counting fence in 1994. However, it is assumed that the effect on the overall exploitation rate was not significant. The exploitation rate (ER) in 1994 was calculated based on the total retained catch of salmon above and below the counting fence and the total returns to the river.

$$ER = \frac{\text{(total \# of salmon retained below and above the counting fence)}}{\text{(\# of salmon counted at the fence)} + \text{(total \# of salmon retained below the counting fence)}}$$

Estimation of Spawning Escapement and Potential Egg Depositions

The spawning escapement in 1994 was obtained by subtracting the recreational catch of small salmon retained above the counting fence from the total returns to the counting fence. Total returns and spawning escapements in 1975-1993 were estimated from angling catches based on the angling exploitation rate in 1994.

The potential egg depositions were calculated on the basis of the total spawning escapement, observed biological characteristics collected from salmon retained in the recreational fishery (mean whole weight of females, percent females) and mean fecundity of 1,783 eggs/kg of body weight (Chadwick et al. 1986). This fecundity value represents a maximum value because of the potential for egg loss due to atresia (O'Connell et al. 1991). (NOTE: Ovary samples were collected in 1994 from salmon retained in the recreational fishery. These samples will subsequently be used to verify the relative fecundity value for Atlantic salmon on the Forteau River used in this document).

Estimation of Target Egg Deposition Requirements

The target egg deposition requirement for conservation of Atlantic salmon stocks on the Forteau River was estimated based on an optimum egg deposition rate of 2.4 eggs/m^2 (Elson 1975) of fluvial parr rearing habitat and 105 eggs/ha of lacustrine area (O'Connell et al. 1991). The total fluvial habitat available was previously estimated at 1,462 m^2 rearing units (one unit = 100 m^2) from a 1:250,000 scale topographical map and a helicopter survey (Anderson 1985). However, the total axial length of accessible tributaries not included in this estimation of rearing units was approximately 61.4 km (Appendix 1), measured from a 1:50,000 scale topographical map with SPANS GIS (Figure 2). Rearing units for these additional streams were estimated based on mean stream widths of one and three metres to give a total for the river (Appendix 1). The actual width of these additional tributaries will be determined in 1995 and a single target will be derived. The total available lacustrine area (520 ha) was measured from digitized 1:50,000 scale topographic maps (Figure 2, Appendix 1).

RESULTS

Recreational Fishery

Recreational effort on the Forteau River in 1994 was 30.4% above that in 1993, 62.7% above the 1984-1991 mean, and 100.4% above the 1978-1983 mean, but the total catch of small and large salmon decreased by 35% compared to 1993, 16% compared to the 1984-1991 mean, and 30.8% compared to the 1978-1983 mean (Table 1). The catch of small salmon in 1994 was 2.3% above the 1992-1993 mean, but 18.5% below the 1984-1991 mean and 32.4% below the 1978-1983 mean. The catch of large salmon in 1994 was 85% below the 1992-1993 mean, 71% below the 1984-1991 mean and 81% below the 1978-1983 mean (Table 1).

The increase in angling effort in 1994 combined with decreased catches does not appear to follow the trend of effort and catch in previous years in which both the effort and catch increased or decreased together in the same year (Figure 3). This change in the established pattern based on historical catch statistics may have been caused by the presence of the counting fence on

the river which resulted in angler expectation that fish were being prevented from moving upstream and would be easier to catch. The catch of small salmon on the Forteau River in 1994 represented the highest proportion of the SFA 14(B) catch (44.6%) since 1964 (Table 1).

Peak angling catches of small salmon below the counting fence on Forteau River in 1994 occurred in standardized (Table 4) week 29 (Figure 4), whereas, peak counts of small salmon at the fence occurred in week 30 (Figure 5) suggesting that the fence may have caused a slight delay in upstream migration. Catches of small salmon above the counting fence occurred in week 36 (Figure 6).

Commercial Fishery.

Only 5.4t (68%) of the 8t commercial salmon quota was caught in 1994 when the fishery closed on 5 October, whereas, the 8t quota in 1993 was taken on 28 July suggesting lower abundance of fish in 1994.

Public consultations held with commercial salmon fishermen in the fall of 1994 indicated that much of the commercial catch in 1994 was composed of larger salmon than in previous years.

Returns and Spawning Escapements to the Forteau River.

A total of 228 small salmon and 74 large salmon were enumerated at the counting fence on Forteau River in 1994 (Table 5). Eight small salmon were observed below the counting fence when it was removed, and were included in the total count. The highest daily count of small salmon was on 26 July and 18 July for large salmon (Figure 7). The period of peak counts coincided with the highest water temperatures and lowest water levels at the fence (Figure 8).

The total returns (including angling catches below the fence) to the Forteau River in 1994 were 458 small salmon and 77 large salmon or 535 fish in total (Table 6).

A total of 309 small and four large salmon were angled and retained above and below the counting fence, resulting in a spawning escapement of 149 small and 73 large salmon (Table 6).

Estimation of Angling Exploitation Rate

A total of 233 small and large salmon were angled and retained immediately below the counting fence in 1994 (Table 6). This represented an angling exploitation rate of 0.4355 on the returning population. In comparison, only 80 of the 302 small and large salmon counted at the fence were retained above, representing an angling exploitation rate of only 0.2649 (Table 6). This difference in the exploitation rate above and below the counting fence was the result of a combination of a delay in peak counts at the fence compared to catches below the fence and the concentration of angling effort in this area compared to previous years according to local Fisheries Officers.

On the basis of total returns and angling catches of small and large salmon on the Forteau River in 1994, the angling exploitation rate on small salmon was 0.6747 (309/458) and 0.0519 (4/77) on large. The angling exploitation rate for small and large salmon combined was 0.5850 (313/535). The combined value was used to estimate returns of both small and large salmon in 1975-1993 because restrictions on the daily bag limit of large salmon would have affected the catch of large salmon in 1994 compared to previous years.

Biological Characteristics

Large salmon angled on the Forteau River in 1994, had an average fork length of 68.7 cm (n=3) and small salmon had an average fork length of 55.1 cm (n=110) which were similar to the fork length of large and small salmon angled in 1975-1993 (Table 7). The sex composition of large salmon on the Forteau River is 53.3% (16/30) female based on angling catches in 1979-1994 (Table 7). This is quite low compared to 78.5% (139/177) female angled on the Pinware River in 1980-1994. (Table 8). However, the sex composition of small salmon on the Forteau in 1975-1994 was 64.2% (39/59) female (Table 7) which is almost twice the 1974-1994 value of 36.1% for Pinware in 1974-1994 (Table 8). The mean whole weight of female salmon on Forteau River was 1.75 kg (n=310) for small in 1975-1994 and 3.85 kg (n=15) for large in 1979-1994 (Table 7). Egg depositions on the Forteau River in 1994 were calculated based on the percentage female and mean weight of females measured in 1994 if the sample size was greater than 30, otherwise, the overall means were used (Table 7).

The smolt age of salmon on the Forteau River was similar for large and small salmon and averaged 4.1 (n=694) overall in 1975-1994 (Table 7). Smolt ages of large and small salmon ranged from two to six years with approximately 80% at age 4 (Table 9).

The sea age of 99.3% of the small salmon sampled in the recreational fishery on the Forteau River in 1975-1994 was one-sea-winter (1SW) (Table 10). The remaining 0.7% were consecutive spawning 1SW fish (Table 10). Large salmon on the Forteau River were 56.7 % virgin multi-sea-winter with the remainder being repeat spawning 1SWs (30%) and MSWs

(13.3%) (Table 10). Forteau River depends heavily on repeat spawners for egg deposition compared to Pinware River, the only other large river system in SFA 14(B) (Table 10). Large salmon on the Pinware were 93.6% MSW (Table 10).

Estimation of Target Spawners and Potential Egg Deposition

Currently, two preliminary egg deposition targets have been derived for Forteau River: 544,200 eggs (target 1) and 838,920 eggs (target 2) (Table 11). Based on the biological characteristics of female salmon in 1975-1994, sufficient female to achieve these targets would come from spawning escapements of 260 (247 small and 14 large) and 402 (381 small and 21 large), respectively (Table 11).

The potential egg deposition for small and large salmon achieved in the Forteau River in 1994, was approximately 523,477 eggs or 96% of target 1 and 62% of target 2 (Table 12).

The percentage of the target eggs achieved on Forteau River in 1994 was slightly above the percentage achieved in 1990-1992 but below most years since 1975 (Table 13). The largest returns of small salmon on the Forteau River were in 1976 but returns have been on a downward trend in recent years (Figure 9).

Returns of small salmon to the Forteau River in 1994 were produced primarily by spawners in 1988 on the basis of an average smolt age of 4 years. Returns in 1994 were only 20% above the corresponding spawning escapement in 1988 (Table 13). On the basis of the relatively low spawning escapements (year i-6) which will contribute to returns in 1995-2000 (Figure 9), it is not anticipated that the current trend of low returns to the Forteau River will change in the next six years.

DISCUSSION

The abundance of small and large salmon on the Forteau River in 1994 was low compared to previous years. This is reflected in both the low recreational and commercial fishery catches as well as in the total returns to the river relative to those for most previous years.

The recreational catches of both small and large salmon on the Forteau River in 1994 were below those in 1993 and below the 1978-1983 and 1984-1991 means. Catches would probably have been even lower if angling effort had not increased by 23%. Catches of large salmon in 1994 were also much lower than the 1992-1993 mean, maybe as a result of the reduction in the seasonal bag limit from four large salmon in 1993 to 2 in 1994 (no seasonal bag limit was in place in 1992). However, because angling effort increased in 1994, compared to 1992 and 1993, the decrease in catches of large salmon may be more reflective of relatively low abundance. The

majority of angling catches in 1994 were removed from the pool located just below the counting fence. For 1995, this pool should be closed to angling, in order to prevent any increase in exploitation because of the counting fence. Given the current status of the stock compared to previous years, closure of this pool would benefit to the river by increasing the spawning escapement.

The method used to calculate the target spawning requirements for the Forteau River in 1994 have a number of limitations which are difficult to quantify. These include the effect of habitat preference of juvenile salmon; the atresia of eggs in the ovary; the dispersal of juveniles from the spawning grounds; and the interaction of anadromous and landlocked forms. These limitations are discussed in detail in O'Connell et al. (1991). However, the method is accepted as a reasonable standard for the evaluation of stock status. In addition, estimates of the accessible rearing habitat, which were taken from published reports, are based solely on aerial surveys. In order to firmly establish the conservation targets necessary to ensure a healthy salmon stock on the Forteau River, a stream survey should be completed in 1995 to verify the aerial survey estimates of the total area available to salmon.

Much has been learned from this initial assessment of the status of the salmon stock on the Forteau River and about stocks in SFA 14(B) in general. However, the returns of salmon to this river should continue to be monitored until conservation targets are established and until it can be determined whether or not the recent fishery management measures implemented in this area will result in improvements to the status of the stocks.

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Table 1. Recreational effort and catch (retained and released) of Atlantic salmon on the Forteau River, 1954–1994 and percent of SFA 14(b).

Year	Effort		Small salmon			Large salmon			Total	%	CPUE
	Rod–days	%SFA	Ret.	Rel.	%SFA	Ret.	Rel.	%SFA	Catch	Large*	
1954	67	.	126	.	.	128	.	.	254	.	3.79
1955	394	86.4	139	.	89.7	242	.	99.2	381	65.8	0.97
1956	306	.	157	.	.	197	.	.	354	58.6	1.16
1957	324	94.2	184	.	80.7	287	.	99.7	471	64.6	1.45
1958	254	92.4	502	.	95.4	50	.	100.0	552	21.4	2.17
1959	261	.	497	.	.	95	.	.	592	15.9	2.27
1960	244	.	385	.	.	52	.	.	437	9.5	1.79
1961	430	91.3	455	.	97.4	110	.	98.2	565	22.2	1.31
1962	301	89.6	401	.	82.5	63	.	96.9	464	12.2	1.54
1963	327	53.7	271	.	64.4	64	.	46.0	335	13.8	1.02
1964	534	44.3	391	.	46.9	129	.	38.5	520	32.3	0.97
1965	737	46.2	336	.	41.9	84	.	21.5	420	17.7	0.57
1966	1065	45.5	466	.	34.9	137	.	39.8	603	29.0	0.57
1967	937	49.3	459	.	40.9	153	.	38.8	612	24.7	0.65
1968	898	40.2	568	.	34.5	118	.	33.1	686	20.5	0.76
1969	873	43.1	525	.	41.5	83	.	30.4	608	12.7	0.70
1970	1351	52.8	629	.	40.2	13	.	4.0	642	2.4	0.48
1971	703	27.5	342	.	36.9	24	.	9.7	366	3.7	0.52
1972	886	37.6	178	.	42.1	5	.	6.3	183	1.4	0.21
1973	1151	39.8	472	.	33.0	20	.	4.6	492	10.1	0.43
1974	785	28.9	258	.	34.9	14	.	4.8	272	2.9	0.35
1975	748	34.3	284	.	26.6	7	.	4.5	291	2.6	0.39
1976	1482	38.0	818	.	32.7	19	.	6.1	837	6.3	0.56
1977	1367	34.9	612	.	36.8	32	.	5.4	644	3.8	0.47
1978	925	38.3	164	.	28.6	19	.	10.4	183	3.0	0.20
1979	996	46.3	394	.	43.7	27	.	22.7	421	14.1	0.42
1980	799	32.3	339	.	36.1	31	.	9.2	370	7.3	0.46
1981	1159	34.6	540	.	31.8	23	.	10.5	563	6.4	0.49
1982	1259	38.4	557	.	43.8	14	.	17.5	571	2.5	0.45
1983	1529	43.3	748	.	37.4	14	.	10.8	762	2.5	0.50
1984	1336	33.4	402	.	40.7	18	.	9.7	420	2.3	0.31
1985	1114	30.4	317	.	29.0	7	.	7.0	324	1.7	0.29
1986	1458	31.4	356	.	33.2	27	.	14.7	383	7.8	0.26
1987	1368	27.4	537	.	28.5	21	.	9.8	558	5.6	0.41
1988	1765	30.9	538	.	33.8	24	.	9.6	562	4.3	0.32
1989	1478	30.2	355	.	30.3	6	.	11.3	361	1.1	0.24
1990	1261	24.8	324	.	30.4	7	.	7.1	331	1.9	0.26
1991	1161	28.9	205	.	17.8	3	.	6.1	208	0.9	0.18
1992	1271	27.5	219	23	25.6	9	0	3.8	251	4.2	0.20
1993	1707	32.2	385	78	36.8	43	4	17.8	510	16.4	0.30
1994	2226	38.3	309	18	44.6	4	0	4.0	331	1.0	0.14
MEANS, 95% CONFIDENCE LIMITS AND N'S PRECEDING 1992:											
Mean(78–83)	1111	38.9	457	.	36.9	21	.	13.5	478	6.0	0.42
95%CL=+/–	836	33.4	244	.	30.5	14	.	7.8	269	1.2	0.30
N	6	6	6	.	6	6	.	6	6	6	6
Mean(84–91)	1368	29.7	379	.	30.5	14	.	9.4	393	3.2	0.29
95%CL=+/–	1195	27.5	285	.	25.1	6	.	7.1	293	1.2	0.23
N	8	8	8	.	8	8	.	8	8	8	8
Mean(92–93)	1489	29.9	302	51	31.2	26	2	10.8	381	10.3	0.25
95%CL=+/–	1281	0	753	299	40	190	23	78	1265	67	0
N	2	2	2	2	2	2	2	2	2	2	2

* Calculated by year of smolt migration.

Table 2. Recreational effort and catch (retained and released) of Atlantic salmon on the Pinware River, 1964–1994, and percent of SFA 14(b).

	Effort		Small salmon			Large salmon			Total	%	
Year	Rod–days	%SFA	Ret.	Rel.	%SFA	Ret.	Rel.	%SFA	Catch	Large*	CPUE
1964	672	55.7	443	.	53.1	206	.	61.5	649	.	0.97
1965	859	53.8	465	.	58.1	307	.	78.5	772	40.9	0.90
1966	1274	54.5	871	.	65.1	207	.	60.2	1078	30.8	0.85
1967	964	50.7	662	.	59.1	241	.	61.2	903	21.7	0.94
1968	1335	59.8	1077	.	65.5	238	.	66.9	1315	26.4	0.99
1969	1154	56.9	740	.	58.5	190	.	69.6	930	15.0	0.81
1970	1207	47.2	937	.	59.8	308	.	96.0	1245	29.4	1.03
1971	1556	68.9	585	.	63.1	223	.	90.3	808	19.2	0.52
1972	1471	62.4	245	.	57.9	75	.	93.8	320	11.4	0.22
1973	1738	57.1	957	.	66.9	412	.	95.4	1369	62.7	0.79
1974	1928	71.1	482	.	65.1	277	.	95.2	759	22.4	0.39
1975	1432	65.7	785	.	73.4	147	.	95.5	932	23.4	0.65
1976	2414	62.0	1680	.	67.3	291	.	93.9	1971	27.0	0.82
1977	2551	65.1	1050	.	63.2	561	.	94.6	1611	25.0	0.63
1978	1488	61.7	409	.	71.4	164	.	89.6	573	13.5	0.39
1979	1153	53.7	507	.	56.3	92	.	77.3	599	18.4	0.52
1980	1677	67.7	599	.	63.9	306	.	90.8	905	37.6	0.54
1981	2194	65.4	1158	.	68.2	197	.	89.5	1355	24.7	0.62
1982	2020	61.6	714	.	56.2	66	.	82.5	780	5.4	0.39
1983	2000	56.7	1252	.	62.6	116	.	89.2	1368	14.0	0.68
1984	2661	66.6	585	.	59.3	167	.	90.3	752	11.8	0.28
1985	1977	54.0	661	.	60.5	88	.	88.0	749	13.1	0.38
1986	2335	50.3	680	.	63.5	156	.	84.8	836	19.1	0.36
1987	2774	55.6	1148	.	60.8	193	.	89.8	1341	22.1	0.48
1988	2961	51.9	824	.	51.8	225	.	89.6	1049	16.4	0.35
1989	2640	53.9	682	.	58.1	46	.	86.8	728	5.3	0.28
1990	3099	61.1	654	.	61.4	91	.	92.9	745	11.8	0.24
1991	2252	56.1	829	.	72.0	45	.	91.8	874	6.4	0.39
1992	2868	61.9	628	38	73.4	229	0	96.2	875	21.6	0.31
1993	3158	59.6	654	336	62.5	199	26	82.2	853	24.1	0.27
1994	3075	52.9	373	68	53.8	97	10	96.0	470	12.9	0.15
MEANS, 95% CONFIDENCE LIMITS AND N'S PRECEDING 1992:											
Mean (78–83)	1755	61.1	773	.	63.1	157	.	86.5	930	18.9	0.52
95%CL = +/–	1345	55.6	405	.	56.6	65	.	80.8	557	7.2	0.40
N	6	6	6	.	6	6	.	6	6	6	6
Mean(84–91)	2587	56.2	758	.	60.9	126	.	89.2	884	13.2	0.35
95%CL = +/–	2272	51.7	608	.	56.2	69	.	87.0	706	8.4	0.28
N	8	8	8	.	8	8	.	8	8	8	8
Mean(92–93)	3013	60.8	641	187	67.9	214	13	89.2	864	22.9	0.29
95%CL = +/–	1171	46	476	1706	1	23	152	0	724	7	0
N	2	2	2	2	2	2	2	2	2	2	2

* Calculated by year of smolt migration.

Table 3. Commercial and recreational salmon fishery management measures implemented in Salmon Fishing Area (SFA) 14(b) in 1989–1994.

1989	1990	1991	1992	1993	1994
Commercial	**Commercial**	**Commercial**	**Commercial**	**Commercial**	**Commercial**
– caught 38t (Oct. 15)	– quota of 50t(10t)(SFA 14) – caught 19t of 50t quota(Aug .) –caught 4t of 10t quota	– quota of 15t – caught 17t (Oct. 15)	– quota of 13t – caught 13t (Jul. 6)	– quota of 8t – caught 8t (Jul. 28)	– quota of 8t – caught 5.4t(Oct. 5)
–number of licenses: 61	–number of licenses: 59	–number of licenses: 58	– number of licenses: 54	– number of licenses: 17	–number of licenses: 13
Recreational	**Recreational**	**Recreational**	**Recreational**	**Recreational**	**Recreational**
– no quota – caught 1226 salmon – seasonal limit 15 salmon – daily limit 2	– no quota – caught 1164 salmon – seasonal limit 15 – daily limit 2	– no quota – caught 1201 salmon – seasonal limit 10 salmon – daily limit of 2 salmon	– quota of 1100 salmon – caught 1094 salmon – seasonal limit 8 salmon – daily limit of 2 salmon	– quota of 1400 salmon – caught 1289 salmon – seasonal limit 8 salmon – daily limit of 1 salmon – only 4 large salmon per license	– no quota – caught 794 – seasonal limit 6 salmon – daily limit of 2 salmon – only 2 large salmon per license

Notes:

Commercial quotas from 1989–1991 are for SFA 14.
Commercial quota for 1990 of 50t for SFA 14; supplementary quota of 10t for SFA 14(b) given after 50t quota caught. SFA 14(b) caught total of 23t.
Commercial quota in 1992–1993 for SFA 14(b)
Recreational quota in 1992–1993 for SFA 14(b) only.

Table 4. Standardized weeks used for analysis of Atlantic salmon run–timing.

Week	Time period
25	June 18 to 24
26	June 25 to July 1
27	July 2 to 8
28	July 9 to 15
29	July 16 to 22
30	July 23 to 29
31	July 30 to August 5
32	August 6 to 12
33	August 13 to 19
34	August 20 to 26
35	August 27 to Sept. 2
36	Sept. 3 to 9
37	Sept. 10 to 16
38	Sept. 17 to 23
39	Sept. 24 to 30
40	Oct. 1 to 7

Table 5. Daily counts of Atlantic salmon and trout and mean daily water level, water and air temperatures at the counting fence on the Forteau River, 1994.

Date	Atlantic salmon		Brook Trout	Water Level (cm)	Water Temp. (C)	Air Temp. (C)
	Small (<63cm)	Large (=>63cm)				
25-Jun	0	0	0	.	10.0	17.0
26-Jun	0	0	0	.	.	.
27-Jun	0	0	0	.	10.0	12.0
28-Jun	0	0	0	.	11.0	14.0
29-Jun	0	0	0	76.0	12.0	13.0
30-Jun	0	0	0	83.5	11.5	17.5
01-Jul	0	0	0	84.5	13.0	21.0
02-Jul	0	0	0	80.8	11.0	8.0
03-Jul	1	0	0	77.5	11.0	11.0
04-Jul	0	0	0	75.3	11.3	13.3
05-Jul	0	0	0	70.3	13.7	16.0
06-Jul	2	0	1	70.3	12.0	14.2
07-Jul	0	0	0	.	.	.
08-Jul	2	1	1	75.3	14.5	14.5
09-Jul	0	0	0	72.0	16.0	19.3
10-Jul	0	0	3	67.7	14.0	12.7
11-Jul	0	1	8	65.4	13.5	18.5
12-Jul	5	1	0	64.1	15.3	18.0
13-Jul	1	1	2	61.4	14.5	14.3
14-Jul	3	0	0	61.1	13.5	16.8
15-Jul	3	3	0	60.4	14.3	17.8
16-Jul	0	2	1	59.9	15.3	15.1
17-Jul	5	2	1	58.8	14.1	16.3
18-Jul	10	11	0	56.1	17.0	21.8
19-Jul	6	4	0	53.5	16.3	17.5
20-Jul	3	0	0	51.7	15.8	14.3
21-Jul	11	6	1	48.5	15.6	15.4
22-Jul	7	5	0	47.3	14.6	12.3
23-Jul	2	1	0	47.0	15.0	13.0
24-Jul	8	3	0	45.8	14.3	10.8
25-Jul	17	1	1	43.6	12.0	13.8
26-Jul	18	5	0	43.0	16.3	18.0
27-Jul	14	4	0	42.3	16.0	15.0
28-Jul	7	2	0	43.0	15.3	18.3
29-Jul	4	1	0	44.3	16.3	16.2
30-Jul	4	1	0	44.1	17.5	19.0
31-Jul	1	0	0	47.1	17.5	19.0
01-Aug	13	1	0	47.1	17.8	16.5
02-Aug	1	0	0	47.0	18.0	17.0
03-Aug	3	0	0	47.5	17.8	17.0
04-Aug	3	2	1	47.4	18.8	16.8
05-Aug	8	3	4	46.6	18.3	19.8
06-Aug	8	0	0	49.5	17.3	12.5
07-Aug	4	2	2	51.9	17.3	16.0
08-Aug	6	2	2	50.9	18.0	17.0
09-Aug	0	0	0	50.3	17.5	16.3
10-Aug	1	2	0	50.0	17.5	15.5
11-Aug	11	1	0	48.4	18.0	14.8
12-Aug	3	0	0	47.0	16.5	13.5
13-Aug	1	0	0	45.0	16.8	15.8
14-Aug	3	0	0	43.3	17.4	17.3

Note: Counting trap was moved on July 7.

(continued next page)

Table 5 (continued).

Date	Atlantic salmon Small (<63cm)	Atlantic salmon Large (=>63cm)	Brook Trout	Water Level (cm)	Water Temp. (C)	Air Temp. (C)
15-Aug	1	0	1	44.8	16.8	14.5
16-Aug	5	0	0	41.0	14.0	15.0
17-Aug	0	0	0	40.5	15.8	14.8
18-Aug	0	1	1	44.3	16.3	16.7
19-Aug	0	0	5	43.0	17.5	17.5
20-Aug	0	1	0	42.3	16.8	16.5
21-Aug	0	0	0	41.0	15.3	15.0
22-Aug	1	2	1	44.5	16.5	16.8
23-Aug	0	0	0	45.0	16.5	16.0
24-Aug	0	0	3	45.0	14.3	12.8
25-Aug	0	0	0	43.0	14.7	14.0
26-Aug	1	0	0	42.0	14.8	15.3
27-Aug	0	0	0	45.0	14.0	11.8
28-Aug	1	0	1	47.0	16.5	14.5
29-Aug	1	0	0	46.8	14.8	12.5
30-Aug	5	1	1	55.8	14.3	14.3
31-Aug	0	0	0	64.0	13.7	14.3
01-Sep	0	1	0	64.0	14.3	14.7
02-Sep	0	0	0	62.0	14.7	15.0
03-Sep	0	0	0	58.0	12.3	11.3
04-Sep	2	0	3	57.0	13.0	12.3
05-Sep	0	0	0	53.5	14.0	20.0
06-Sep	1	0	4	50.1	14.0	14.8
07-Sep	0	0	0	48.1	13.0	11.8
08-Sep	0	0	1	49.8	13.5	15.3
09-Sep	0	0	0	49.1	14.5	12.8
10-Sep	0	0	0	49.1	14.5	11.5
11-Sep	0	0	2	48.0	12.0	8.0
12-Sep	1	0	2	52.8	11.3	7.0
13-Sep	0	0	0	65.6	10.0	10.8
14-Sep	1	0	2	73.0	11.0	11.3
15-Sep	0	0	0	76.2	9.3	9.0
16-Sep	0	0	1	74.8	9.0	8.7
17-Sep	0	0	1	71.2	9.7	11.3
18-Sep	0	0	1	71.2	11.7	9.7
19-Sep	0	0	1	69.3	10.5	8.3
20-Sep	0	0	1	68.8	10.3	9.8
21-Sep	0	0	1	65.9	10.8	8.0
22-Sep	0	0	1	63.3	10.3	6.7
23-Sep	0	0	3	60.3	11.0	11.7
24-Sep	0	0	0	57.5	10.7	14.0
25-Sep	0	0	10	54.7	10.7	12.3
26-Sep	0	0	9	51.8	11.8	13.3
27-Sep	0	0	3	49.9	11.0	10.3
28-Sep	1	0	1	47.0	10.0	5.8
29-Sep	0	0	10	45.0	9.3	8.0
30-Sep	0	0	1	42.8	9.3	7.8
01-Oct	0	0	0	41.3	9.3	8.0
02-Oct	0	0	0	43.0	8.7	8.0
03-Oct	8	0	0	51.5	7.0	7.0
Total	228	74	99			

Table 6. Total returns of small and large Atlantic salmon, spawning escapement, retained catch and effort, catch–per–unit–effort (CPUE), and angling exploitation rate (ER) above and below the counting fence on the Forteau River, 1994.

	Small (< 63cm)	Large (>= 63cm)	Total	Angling Effort (rod days)	CPUE	ER
No. at fence	228	74	302			
No. angled Below Fence	230	3	233	1803	0.13	0.4355 (233/535)
Total returns	458	77	535			
No. angled Above Fence	79	1	80	423	0.19	0.2649 (80/302)
Spawning Escapement	149	73	222			

Table 7. Biological Characteristics of small (< 63cm) and large (>= 63cm) virgin and repeat spawners Atlantic salmon of the Forteau River, 1975-1994. Information was collected from the recreational fishery.

		FORK LENGTH (cm)					FORK LENGTH FEMALES (cm)					WHOLE WEIGHT (kg)					WHOLE WEIGHT FEMALES (cm)					NO.=	FEMALE		RIVAGE	
		N	MEAN	MIN	MAX	STD	N	MEAN	MIN	MAX	STD	N	MEAN	MIN	MAX	STD	N	MEAN	MIN	MAX	STD	SEX ED	N	%	N	MEAN
SIZE	YY																									
Large	79	2	75.0	75.0	75.0	0.0	0	.	.	.	.	2	4.10	4.10	4.10	0.00	0	.	.	.	.	2	0	.	2	4.0
	80	10	72.9	67.0	78.0	3.8	7	72.4	67.0	78.0	4.2	10	4.07	3.00	4.50	0.43	7	3.99	3.00	4.50	0.56	10	7	70.0	10	3.8
	81	7	69.9	63.0	79.5	7.2	2	71.0	68.0	74.0	4.2	7	3.80	3.00	4.80	0.63	2	4.65	4.50	4.80	0.21	7	2	28.6	7	3.6
	90	3	70.0	65.0	78.0	7.0	1	67.0	67.0	67.0	.	3	3.37	2.20	5.00	1.46	1	2.90	2.90	2.90	.	3	1	33.3	3	4.0
	91	1	69.2	69.2	69.2	.	1	69.2	69.2	69.2	.	1	3.00	3.00	3.00	.	1	3.00	3.00	3.00	.	1	1	100.0	1	4.0
	93	6	72.5	63.0	77.0	5.5	3	76.7	76.0	77.0	0.6	6	3.68	2.30	4.70	0.86	3	4.27	3.70	4.70	0.51	5	3	60.0	6	4.2
	94	3	68.7	63.0	79.0	9.0	2	71.5	64.0	79.0	10.6	3	1.86	1.86	1.86	.	1	1.86	1.86	1.86	.	2	2	100.0	3	4.3
	79 93	29	71.8	63.0	79.5		14	72.8	67.0	78.0		29	3.82	2.20	5.00		14	3.99	2.90	4.80		28	14	50.0	29	3.9
	79 94	32	71.5	63.0	79.5	5.5	16	72.5	64.0	79.0	4.7	30	3.75	1.86	5.00	0.80	15	3.85	1.86	4.80	0.84	30	16	53.3	32	3.9
Small	YY																									
	75	0	.	.	.	.	0	.	.	.	.	0	.	.	.	.	0	.	.	.	.	69	60	87.0	69	4.3
	79	59	54.2	51.0	60.0	2.0	25	53.9	51.0	56.0	1.8	58	1.76	1.40	2.20	0.18	25	1.76	1.40	2.10	0.16	59	25	42.4	56	4.0
	80	68	55.0	47.0	62.0	3.1	52	54.6	47.0	62.0	3.3	68	1.89	1.00	2.80	0.40	52	1.87	1.00	2.80	0.40	68	52	76.5	68	4.3
	81	174	54.3	43.0	62.0	2.9	103	54.0	43.0	62.0	2.8	174	1.80	1.00	2.80	0.35	103	1.83	1.00	2.80	0.33	173	103	59.5	174	4.0
	82	56	53.3	47.0	59.0	2.6	31	53.0	47.0	58.0	2.4	56	1.72	1.00	3.30	0.36	31	1.71	1.00	3.30	0.39	55	31	56.4	56	4.0
	89	13	55.0	51.0	58.0	2.2	8	54.2	51.0	58.0	2.3	14	1.70	1.00	2.10	0.29	8	1.65	1.40	2.00	0.19	11	8	72.7	38	4.1
	90	34	56.2	52.0	60.0	2.1	18	56.8	55.0	60.0	1.2	34	1.70	1.30	2.10	0.18	19	1.73	1.50	2.10	0.18	33	19	57.6	32	4.2
	91	11	55.1	47.0	59.7	3.7	7	54.7	47.0	59.7	4.2	11	1.61	1.00	2.00	0.30	7	1.56	1.00	2.00	0.33	7	7	100.0	0	.
	93	60	55.4	51.0	61.5	2.8	35	54.7	51.0	61.5	2.6	57	1.68	1.00	2.50	0.32	34	1.67	1.00	2.30	0.31	56	35	62.5	59	3.9
	94	110	55.1	47.5	61.0	2.7	39	54.8	47.5	60.5	2.6	46	1.44	0.94	2.00	0.25	31	1.46	0.94	2.00	0.26	59	39	66.1	110	4.0
	75 93	475	54.6	43.0	62.0		279	54.1	43.0	62.0		472	1.68	1.00	3.30		279	1.78	1.00	3.30		531	340	64.0	552	3.7
	75 94	585	54.7	43.0	62.0	2.8	318	54.4	43.0	62.0	2.8	518	1.77	0.94	3.30	0.35	310	1.75	0.94	3.30	0.34	590	379	64.2	662	4.1
Small	YY																									
&	75	0	.	.	.	.	0	.	.	.	.	0	.	.	.	.	0	.	.	.	.	69	60	87.0	69	4.3
Large	79	61	54.9	51.0	75.0	4.2	25	53.9	51.0	56.0	1.8	60	1.83	1.40	4.10	0.46	25	1.76	1.40	2.10	0.16	61	25	41.0	58	4.0
	80	78	57.3	47.0	78.0	6.8	59	56.7	47.0	78.0	6.8	78	2.17	1.00	4.50	0.84	59	2.12	1.00	4.50	0.81	78	59	75.6	78	4.2
	81	181	54.9	43.0	79.5	4.4	105	54.4	43.0	74.0	3.6	181	1.96	1.00	4.80	0.52	105	1.89	1.00	4.80	0.51	180	105	58.3	181	4.0
	82	56	53.3	47.0	59.0	2.6	31	53.0	47.0	58.0	2.4	56	1.72	1.00	3.30	0.36	31	1.71	1.00	3.30	0.39	55	31	56.4	56	4.0
	89	13	55.0	51.0	58.0	2.2	8	54.2	51.0	58.0	2.3	14	1.70	1.00	2.10	0.29	8	1.65	1.40	2.00	0.19	11	8	72.7	38	4.1
	90	37	57.3	52.0	78.0	4.6	19	57.3	55.0	67.0	2.6	37	1.84	1.30	5.00	0.60	20	1.79	1.50	2.90	0.32	36	20	55.6	35	4.2
	91	12	56.3	47.0	69.2	5.4	8	56.5	47.0	69.2	6.4	12	1.73	1.00	3.00	0.49	8	1.74	1.00	3.00	0.59	8	8	100.0	1	4.0
	93	66	57.0	51.0	77.0	5.8	38	56.4	51.0	77.0	6.5	63	1.87	1.00	4.70	0.71	37	1.88	1.00	4.70	0.79	61	38	62.3	65	3.9
	94	113	55.5	47.5	79.0	3.7	41	55.7	47.5	79.0	4.7	47	1.45	0.94	2.00	0.26	32	1.47	0.94	2.00	0.27	61	41	67.2	113	4.0
	75 93	504	55.6	43.0	79.5		293	55.2	43.0	78.0		501	1.92	1.00	5.00		293	1.89	1.00	4.80		559	354	63.3	581	4.1
	75 94	617	55.6	43.0	79.5	4.8	334	55.2	43.0	79.0	4.8	548	1.88	0.94	5.00	0.53	325	1.85	0.94	4.80	0.58	620	395	63.7	694	4.1

Table 8. Biological characteristics of small (< 63cm) and large (> = 63cm) virgin and repeat spawners Atlantic salmon of the Pinware River, 1974-1994. Information was collected from the recreational fishery.

			FORK LENGTH (cm)				FORK LENGTH FEMALES (cm)					WHOLE WEIGHT (kg)					WHOLE WEIGHT FEMALES (cm)					NO.- SEX ED	FEMALE		RIVAGE	
		N	MEAN	MIN	MAX	STD	N	MEAN	MIN	MAX	STD	N	MEAN	MIN	MAX	STD	N	MEAN	MIN	MAX	STD		N	%	N	MEAN
SIZE	YY																									
Large	80	91	73.9	63.0	94.0	5.6	74	73.4	64.0	81.0	4.4	91	4.67	2.20	8.50	1.11	74	4.71	3.50	6.80	0.87	29	24	82.8	33	3.9
	81	92	75.4	63.0	86.0	3.6	70	75.3	64.0	82.0	4.5	92	4.67	3.00	7.00	0.70	70	4.68	3.00	7.00	0.73	90	70	77.8	92	3.9
	82	29	73.5	68.0	87.5	3.8	20	73.6	69.0	87.5	4.2	29	4.36	3.00	7.40	0.92	20	4.51	3.10	7.40	0.99	26	20	76.9	29	4.2
	85	4	67.4	63.0	71.0	3.3	4	67.4	63.0	71.0	3.3	4	3.30	2.90	3.50	0.27	4	3.30	2.90	3.50	0.27	4	4	100.0	4	4.7
	88	11	80.2	76.2	85.1	2.8	10	79.8	76.2	83.8	2.4	11	5.20	4.10	5.90	0.51	10	5.13	4.10	5.70	0.48	11	10	90.9	11	4.0
	90	2	77.2	72.9	81.5	6.1	2	77.2	72.9	81.5	6.1	2	5.15	4.00	6.30	1.63	2	5.15	4.00	6.30	1.63	2	2	100.0	2	3.5
	91	3	76.0	72.0	78.0	3.5	2	75.0	72.0	78.0	4.2	3	4.67	4.00	5.30	0.65	2	4.65	4.00	5.30	0.92	2	2	100.0	3	4.3
	92	2	76.5	76.0	77.0	0.7	1	77.0	77.0	77.0	.	2	4.30	4.30	4.30	0.00	1	4.30	4.30	4.30	.	2	1	50.0	2	3.0
	93	11	77.5	63.0	86.0	6.2	6	74.9	63.0	79.5	5.7	9	4.83	2.30	6.50	1.23	4	4.28	2.30	5.70	1.42	11	6	54.5	11	3.5
	94	6	78.7	69.9	86.0	6.3	0	.	.	.	.	0	.	.	.	.	0	.	.	.	.	0	0	.	6	4.2
80	93	187	75.1	63.0	94.0		139	74.9	63.0	87.5	4.3	195	4.63	2.20	8.50	0.87	137	4.65	2.30	7.90	0.84	177	139	78.5	187	3.9
80	94	193	75.2	63.0	94.0	4.7	143	74.9	63.0	87.5	4.3	195	4.63	2.20	8.50	0.87	137	4.65	2.30	7.90	0.84	177	139	78.5	193	4.0
Small	YY											0	.	.	.	.	0	.	.	.	.	187	67	35.8	188	4.6
	74	0	.	.	.	.	0	.																		
	80	99	54.7	40.0	62.0	4.0	14	54.2	40.0	62.0	4.0	101	2.02	1.00	8.00	0.83	34	1.93	1.20	4.10	0.55	71	34	47.9	103	4.0
	81	388	52.6	43.0	61.0	2.6	133	52.7	44.0	61.0	2.9	388	1.77	1.00	3.00	0.32	133	1.77	1.00	3.00	0.38	376	133	35.4	387	4.4
	82	261	53.6	37.5	62.0	3.5	70	53.6	47.5	59.4	2.6	260	1.70	1.20	2.80	0.25	70	1.65	1.20	2.40	0.21	203	70	34.5	261	4.2
	85	26	53.9	50.0	57.5	2.5	5	55.2	50.0	57.5	3.1	25	1.66	1.10	2.30	0.26	5	1.90	1.40	2.30	0.32	26	5	19.2	26	4.5
	88	3	53.1	52.7	53.3	0.3	1	53.3	53.3	53.3	.	3	1.50	1.40	1.60	0.10	1	1.50	1.50	1.50	.	2	1	50.0	3	5.0
	89	15	54.8	45.0	60.0	3.2	4	54.5	52.0	55.5	1.6	0	.	.	.	.	0	.	.	.	.	14	4	28.6	16	4.0
	90	15	56.2	49.9	60.4	2.5	9	56.0	49.9	58.5	2.7	14	1.98	1.50	2.40	0.20	9	1.98	1.50	2.40	0.24	15	9	60.0	15	4.3
	91	4	54.5	53.0	58.0	2.4	2	56.0	54.0	58.0	2.8	4	1.85	1.70	2.20	0.24	2	1.95	1.70	2.20	0.35	4	2	50.0	4	4.0
	92	2	55.0	54.0	56.0	1.4	0	.	.	.	.	2	1.85	1.70	2.00	0.21	0	.	.	.	.	2	0	.	1	4.0
	93	36	55.0	47.7	60.0	2.8	12	54.3	47.7	59.5	3.5	35	1.71	1.00	2.30	0.28	11	1.65	1.00	2.20	0.35	33	12	36.4	36	4.0
	94	35	55.0	48.5	59.0	2.5	1	57.0	57.0	57.0	.	8	1.95	1.50	2.40	0.30	1	2.10	2.10	2.10	.	2	1	50.0	33	4.2
74	93	849	53.4	37.5	62.0		270	53.4	40.0	62.0		834	1.78	1.00	8.00		265	1.76	1.00	4.10		933	337	36.1	1040	4.3
74	94	884	53.5	37.5	62.0	3.2	271	53.4	40.0	62.0	3.1	842	1.78	1.00	8.00	0.41	266	1.76	1.00	4.10	0.37	935	338	36.1	1073	4.3
Small	YY						0	.	.	.	.	0	.	.	.	.	0	.	.	.	.	187	67	35.8	188	4.6
&	74	0	.	.	.	.																				
Large	80	132	59.5	40.0	94.0	9.4	58	62.2	40.0	81.0	10.5	136	2.66	1.00	8.50	1.45	58	3.08	1.20	6.80	1.55	100	58	58.0	136	4.0
	81	480	57.0	43.0	86.0	9.4	203	60.5	44.0	82.0	11.2	480	2.32	1.00	7.00	1.22	203	2.77	1.00	7.00	1.48	466	203	43.6	479	4.3
	82	290	55.6	37.5	87.5	6.9	90	58.0	47.5	87.5	8.9	289	1.96	1.20	7.90	0.88	90	2.29	1.20	7.90	1.29	229	90	39.3	290	4.2
	85	30	55.7	50.0	71.0	5.3	9	60.6	50.0	71.0	7.1	29	1.89	1.10	3.50	0.63	9	2.52	1.40	3.50	0.79	30	9	30.0	30	4.6
	88	14	74.4	52.7	85.1	11.8	11	77.4	53.3	83.8	8.3	14	4.41	1.40	5.90	1.64	11	4.80	1.50	5.70	1.18	13	11	84.6	14	4.2
	89	15	54.8	45.0	60.0	3.2	4	54.5	52.0	55.5	1.6	0	.	.	.	.	0	.	.	.	.	14	4	28.6	16	4.0
	90	17	58.7	49.9	81.5	7.5	11	59.8	49.9	81.5	9.3	16	2.37	1.50	6.30	1.18	11	2.55	1.50	6.30	1.40	17	11	64.7	17	4.2
	91	7	63.7	53.0	78.0	11.8	4	65.5	54.0	78.0	11.4	7	3.06	1.70	5.30	1.56	4	3.30	1.70	5.30	1.66	6	4	66.7	7	4.1
	92	4	65.7	54.0	77.0	12.4	1	77.0	77.0	77.0	.	4	3.07	1.70	4.30	1.42	1	4.30	4.30	4.30	.	4	1	25.0	3	3.3
	93	47	60.2	47.7	86.0	10.4	18	60.8	47.7	79.5	10.4	44	2.35	1.00	6.50	1.40	15	2.35	1.00	5.70	1.40	44	18	40.9	47	3.9
	94	41	58.4	48.5	86.0	9.1	1	57.0	57.0	57.0	.	8	1.95	1.50	2.40	0.30	1	2.10	2.10	2.10	.	2	1	50.0	39	4.2
74	93	1036	57.3	37.5	94.0		409	60.7	40.0	87.5		1019	2.29	1.00	8.50		402	2.74	1.00	7.90		1110	476	42.9	1227	4.3
74	94	1077	57.4	37.5	94.0	9.0	410	60.7	40.0	87.5	10.7	1027	2.29	1.00	8.50	1.22	403	2.74	1.00	7.90	1.48	1112	477	42.9	1266	4.3

Table 9. Smolt age distribution of small and large Atlantic salmon on the Forteau River, 1979–1994. Smolt age was determined from scale samples collected from fish landed in the recreational fishery.

Year	N	Smolt Age % 2	3	4	5	6
Large salmon (>= 63cm)						
1979	2			100.0		
1980	10		20.0	80.0		
1981	7	14.3	28.6	42.9	14.3	
1982	3			100.0		
1990	1			100.0		
1993	6			83.3	16.7	
1994	3			66.7	33.3	
Mean(79–93)		14.3	24.3	84.4	15.5	0
Mean(79–94)		14.3	24.3	81.8	21.4	0
Small salmon (< 63cm)						
1979	56		10.7	75.0	14.3	
1980	68		2.9	69.1	25.0	2.9
1981	174		17.2	63.8	18.4	0.6
1982	56		12.5	76.8	8.9	1.8
1989	11		9.1	72.7	18.2	
1990	31		9.7	61.3	25.8	3.2
1993	59		11.9	84.7	3.4	
1994	109		10.1	76.4	12.8	
Mean(79–93)		0	10.6	83.9	16.3	2.1
Mean(79–94)		0.0	10.5	72.5	15.9	2.1

Table 10. Sea–age composition of small and large Atlantic salmon on Forteau River and Pinware River, 1974–1994. Information was obtained from scale samples collected in the recreational fishery. "CS" refers to consecutive spawners and AS" refers to alternate spawners.

			Small salmon				Large salmon				
River	Year	Total No. Aged	N	% 1SW	% CS 1SW	N	% MSW	% CS 1SW	% AS 1SW	% CS MSW	% AS MSW
Forteau River	1975	66	66	100.0	0.0	0	.	.	.	.	.
	1979	58	56	100.0	0.0	2	0.0	50.0	50.0	0.0	0.0
	1980	78	68	100.0	0.0	10	100.0	0.0	0.0	0.0	0.0
	1981	181	175	100.0	0.0	6	33.3	0.0	16.7	50.0	0.0
	1982	56	55	98.2	1.8	1	100.0	0.0	0.0	0.0	0.0
	1989	38	38	97.4	2.6	0	.	.	.	.	.
	1990	35	33	100.0	0.0	2	0.0	100.0	0.0	0.0	0.0
	1993	65	59	100.0	0.0	6	66.7	16.7	0.0	0.0	16.7
	1994	114	111	98.2	1.8	3	0.0	100.0	0.0	0.0	0.0
	Total	625	595	99.3	0.7	30	56.7	23.3	6.7	10.0	3.3
Pinware River	1974	189	122	100.0	0.0	67	100.0	0.0	0.0	0.0	0.0
	1980	136	100	100.0	0.0	36	91.7	0.0	2.8	0.0	5.6
	1981	480	386	99.7	0.3	93	94.6	2.2	2.2	1.1	0.0
	1982	290	262	100.0	0.0	28	82.1	3.6	10.7	0.0	3.6
	1985	30	26	100.0	0.0	4	100.0	0.0	0.0	0.0	0.0
	1988	14	3	100.0	0.0	11	90.9	0.0	9.1	0.0	0.0
	1990	17	15	93.3	6.7	2	100.0	0.0	0.0	0.0	0.0
	1991	7	4	100.0	0.0	3	100.0	0.0	0.0	0.0	0.0
	1992	3	1	100.0	0.0	2	100.0	0.0	0.0	0.0	0.0
	1993	47	37	100.0	0.0	10	80.0	0.0	20.0	0.0	0.0
	1994	39	29	100.0	0.0	9	88.9	0.0	0.0	11.1	0.0
	Total	1252	1077	99.8	0.2	265	93.6	1.1	3.4	0.8	1.1

Table 11. Estimation of target egg deposition and spawner requirements for the Forteau River.
Target 1 based on mean width of 1 m and Target 2 based on mean width of 3 m for additional tributaries.

Estimation of Target Egg Deposition Requirement:

	Target 1	Target 2	
Rearing Units (100 sq. m)	2040	3268	(this document)
Lacustrine Area (ha)	520	520	(this document)

Minimum Egg Deposition Requirement based on:
240 eggs per Fluvial Rearing Unit (Elson, 1975)
105 eggs per ha of Lacustrine Area (O'Connell et al., 1991)

	Target 1	Target 2
=	(2040 x 240) + (520 x 105)	(3268 x 240) + (520 x 105)
=	544,200	838,920

Biological Characteristics:

Fecundity		1,783 eggs / kg (Chadwick et al.,1986)
Small – (<63 cm)	% overall	94.8 (n=617) (recreational, 1975–94)
	% female	64.2 (n=590) (recreational, 1975–94)
	mean wt. females	1.75 kg(n=310(recreational, 1975–94)
Large – (>=63 cm)	% overall	5.2 (n=617) (recreational, 1975–94)
	% female	53.3 (n=30) (recreational, 1975–94)
	mean wt. females	3.85 kg(n=15) (recreational, 1975–94)

Estimation of Eggs per Spawner:

Small	=	(% small * % female * mean wt. * fecundity)
	=	(.948 * .642 * 1.75 * 1783)
	=	1899
Large	=	(%large * % female * mean wt. * fecundity)
	=	(.052 * .533 * 3.85 * 1783)
	=	190

Estimation of Target Spawner Requirement for Sufficient Females:

= egg requirements / eggs per spawner

	Target 1	Target 2
	544,200	838,920
=	------	------
	2089	2089
=	260 (small and large)	402 (small and large)

Table 12. Estimation of Atlantic salmon potential egg deposition and percentage of preliminary targets achieved on the Forteau River in 1994.

Biological Characteristics, 1994:			
Fecundity		1,783 eggs / kg	(Chadwick et al, 1986)
Small – (<63 cm)	% overall	75.5	(counting fence, 1994)
	% female	66.1 (n=59)	(recreational, 1994)
	mean wt. female	1.46 kg (n=32)	(recreational, 1994)
Large – (>=63 cm)	% overall	24.5	(counting fence, 1994)
	% female	53.3 (n=7)	(recreational, 1975–94)
	mean wt. female	3.85 kg(n=6)	(recreational, 1975–94)

Estimation of Percent of Target Eggs Achieved, 1994:

= potential egg depositions / target egg deposition requirement x 100

$$= \frac{(\text{small spawners} * \%\text{female} * \text{mean wt} * \text{fecundity}) + (\text{large spawners} * \%\text{female} * \text{mean wt} * \text{fecundity})}{\text{Target Egg Deposition Requirement}}$$

$$= \frac{(149 * .661 * 1.46 * 1{,}783) + (73 * .533 * 3.85 * 1{,}783)}{\text{Target Egg Deposition Requirement}} \times 100$$

	Target 1	Target 2
=	$\frac{523{,}477}{544{,}200} \times 100$	$\frac{523{,}477}{838{,}920} \times 100$
=	96%	62%

Table 13. Atlantic salmon assessment results for 1994 and retrospective analysis for 1975 – 1993 based on angling catches and angling exploitation rate derived for for the Forteau River, 1994. Target 1 and Target 2 refer to the preliminary egg deposition targets.

STOCK: Forteau River, SFA 14(b)
TARGET–1: 5.4 x 10^5
TARGET–2: 8.4 x 10^5

Year	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	MIN	MAX	MEAN
Total Angling Catch Retained:																							
Small	284	818	612	164	394	339	540	557	748	402	317	356	537	538	355	324	205	219	385	309	164	818	420
Large	7	19	32	19	27	31	23	14	14	18	7	27	21	24	6	7	3	9	43	4	3	43	18
Angling Catch Retained Below Counting Fence:																							
Small	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	230	.	.	.
Large	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3			
Counts at Fence:																							
Small	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	228	.	.	.
Large	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	74	.	.	.
Estimated Returns *:																							
Small	485	1398	1046	280	674	579	923	952	1279	687	542	609	918	920	607	554	350	374	658	458	280	1398	715
Large	12	32	55	32	46	53	39	24	24	31	12	46	36	41	10	12	5	15	74	77	5	77	34
Potential Spawning Escapement:																							
Small	201	580	434	116	280	240	383	395	531	285	225	253	381	382	252	230	145	155	273	149	116	580	295
Large	5	13	23	13	19	22	16	10	10	13	5	19	15	17	4	5	2	6	31	73	2	73	16
Target 1:																							
% of Target Eggs Met (Small + Large) **:																							
	104	223	175	52	81	133	144	132	202	114	86	106	150	152	102	78	49	61	114	96	49	223	118
Target 2:																							
% of Target Eggs Met (Small + Large) **:																							
	67	194	150	34	53	86	93	85	131	74	56	69	97	99	66	51	32	40	74	62	32	194	81

* Total returns based on 1994 angling exploitation rate of 0.5850

** Biological characteristics: % females for 1975 but used overall mean weight of females from 1979 – 1994.
1975 – % females, 1975; mean weight of females, 1979 – 1994.
1976 – 1978, 1983 – 1988, and 1991 – 1992 – mean weight of females, 1979 – 1994, and percent females, 1975 – 1994 for small and large.
Large salmon, 1975 – 1994 except 1980 – 1981 – mean female characteristics for 1979 – 1994.

Figure 1. Map of Labrador indicating the location of the rivers in Salmon Fishing Area (SFA) 14(b): 1) Forteau River, 2) L'Anse au Loup River, and 3) Pinware River.

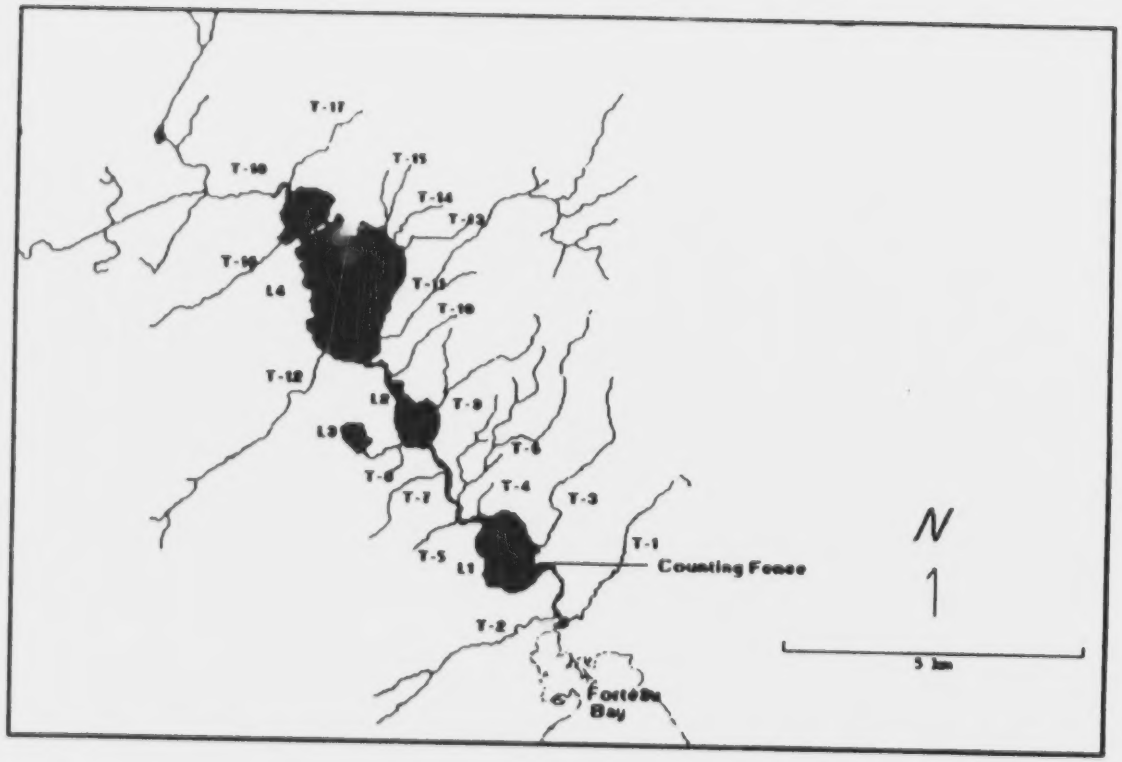

Figure 2. Map of the Forteau River system from mouth to Inside Pond (L4). The counting fence was installed at the mouth of First Pond (L1). The axial length (m) of tributaries (T) and lacustrine habitat (ha; L) digitized from a 1:50,000 topographical map (SPANS GIS) are given in Appendix 1.

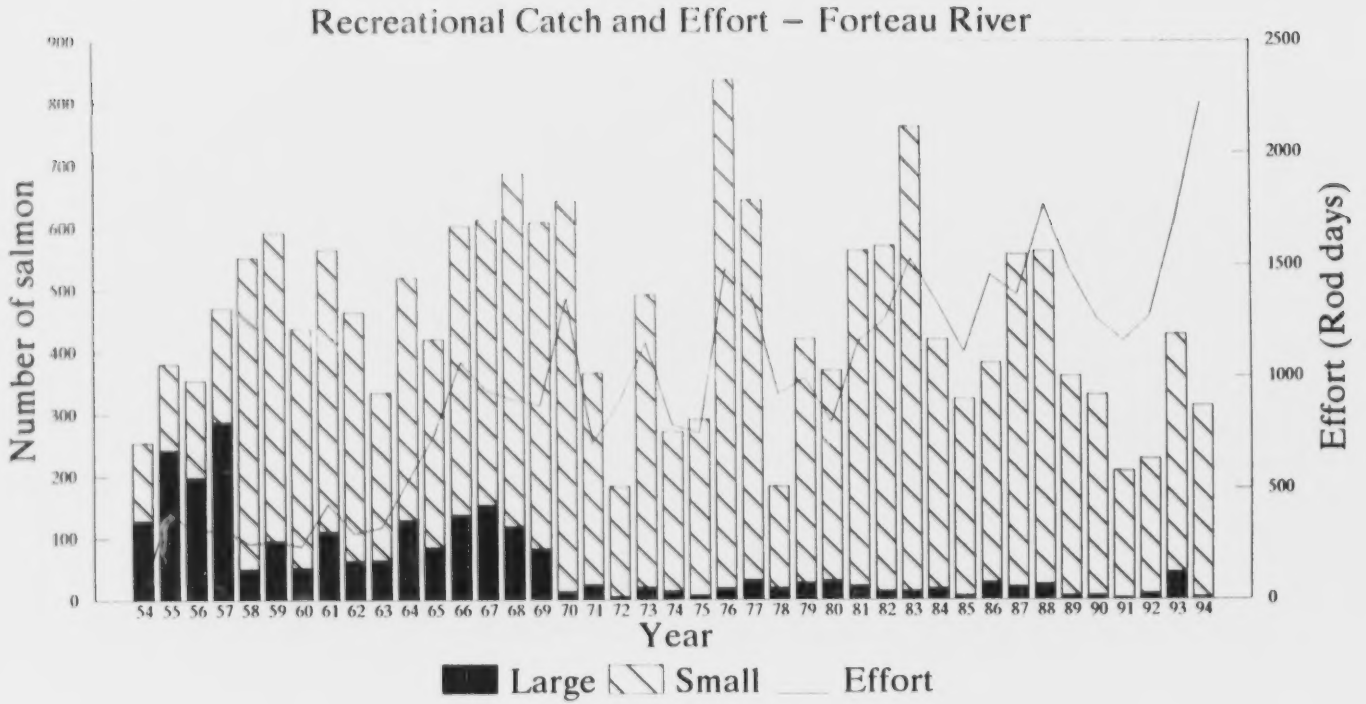

Figure 3. Recreational catch and effort on the Forteau River, 1954–1994. Refer to Table 1 for actual values.

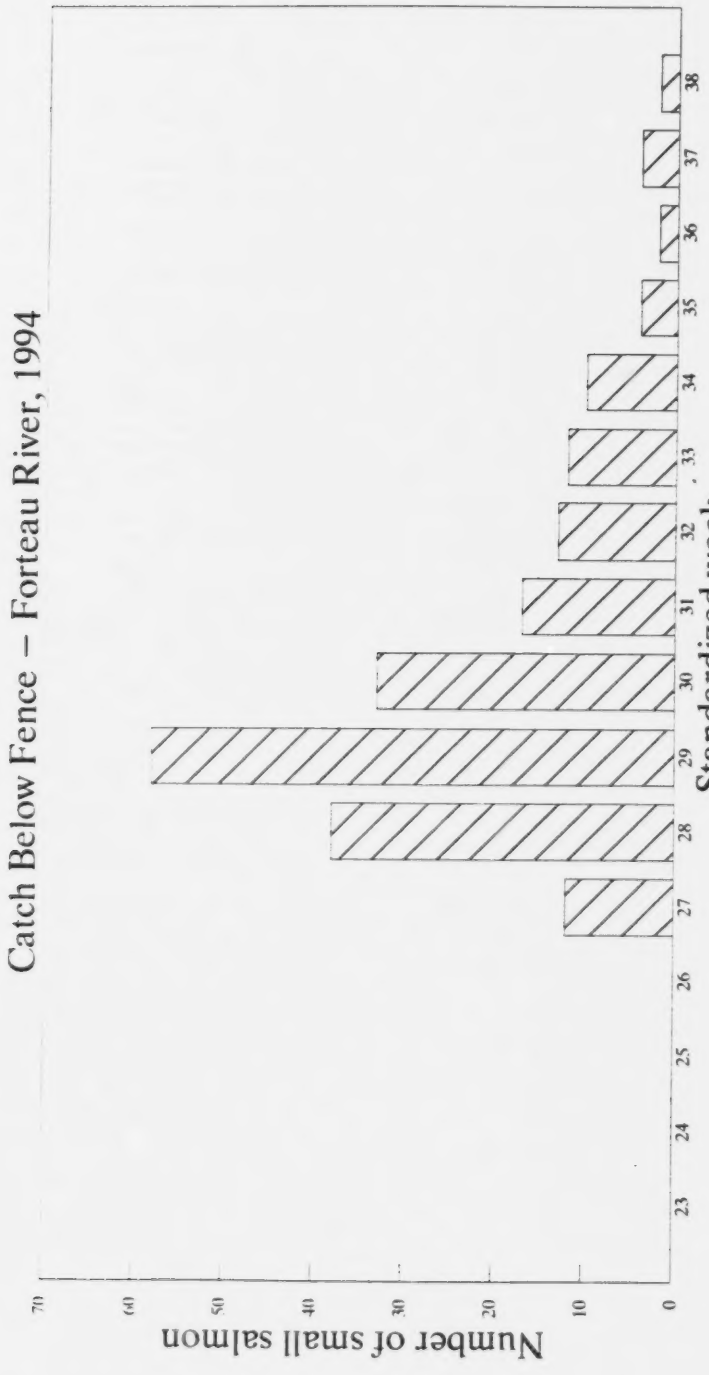

Figure 4. Recreational catch of small salmon below the counting fence on the Forteau River, 1994.

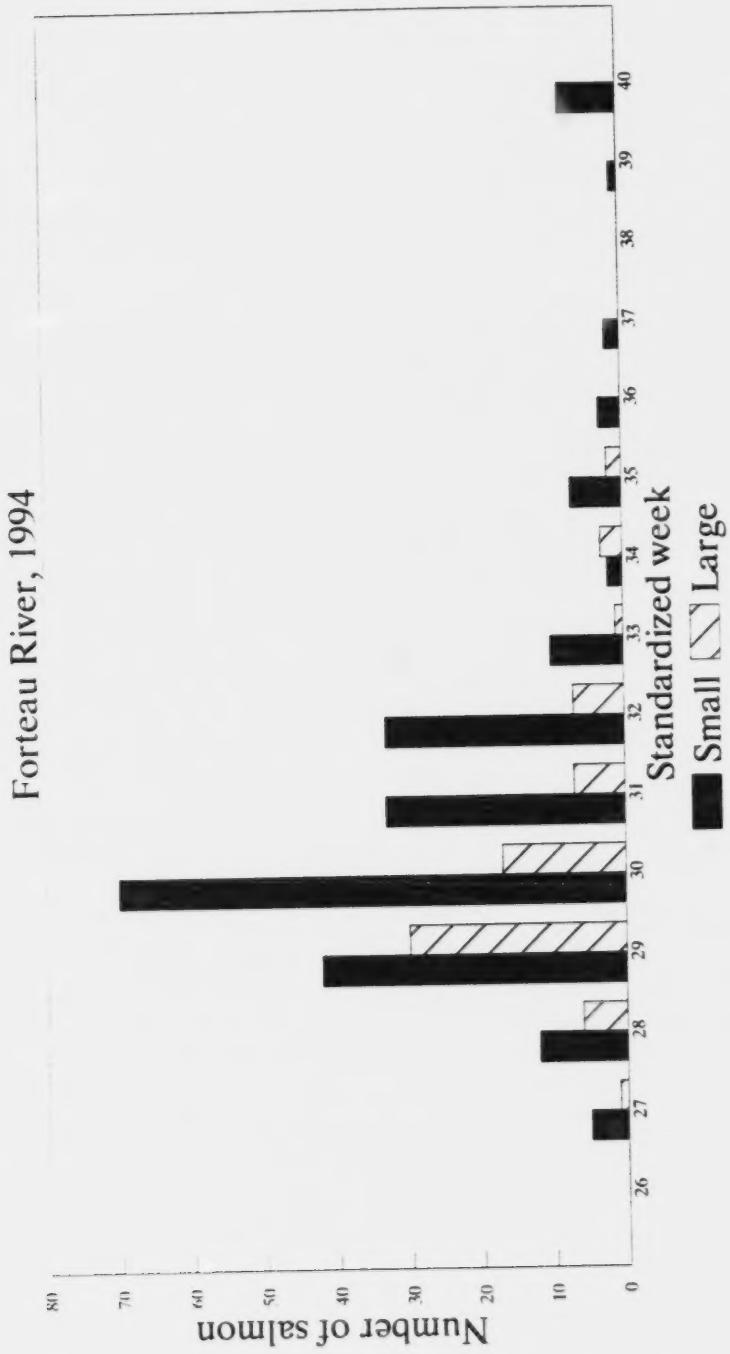

Figure 5. Weekly counts of small and large salmon at the counting fence on Forteau River, 1994.

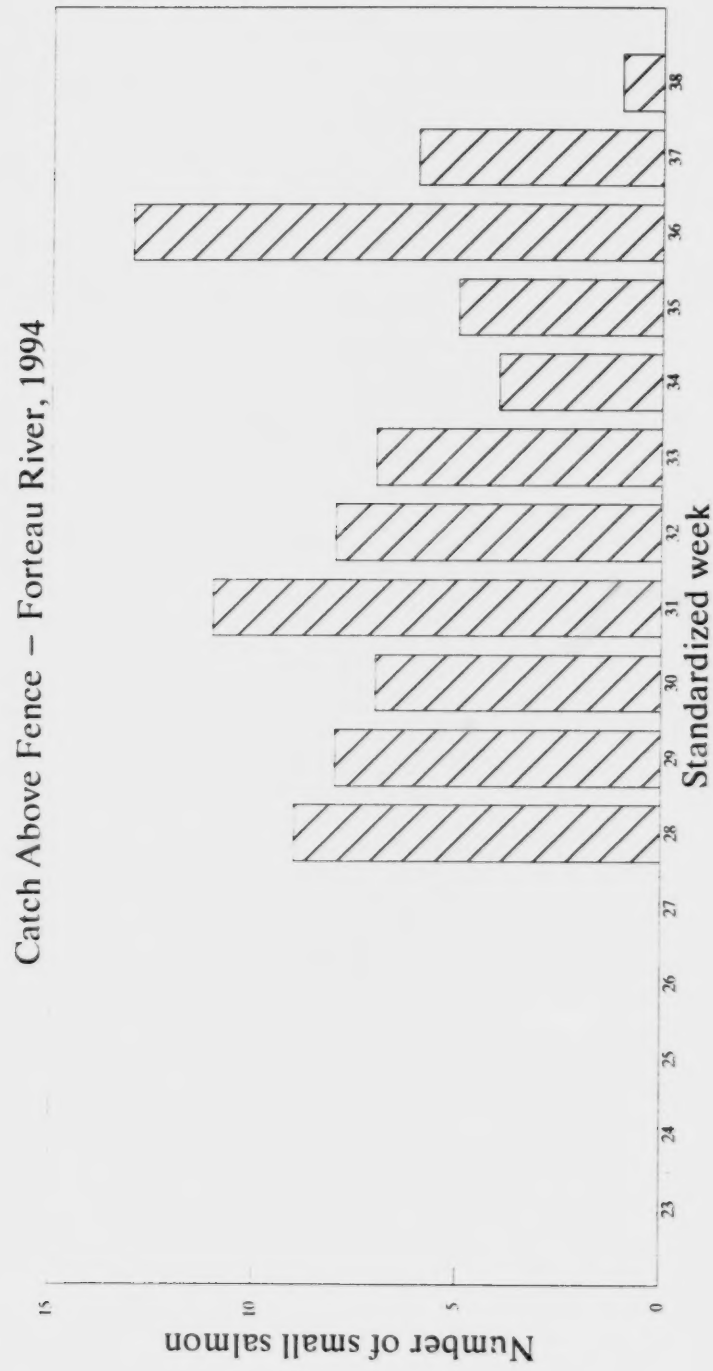

Figure 6. Recreational catch of small salmon above the counting fence on the Forteau River, 1994.

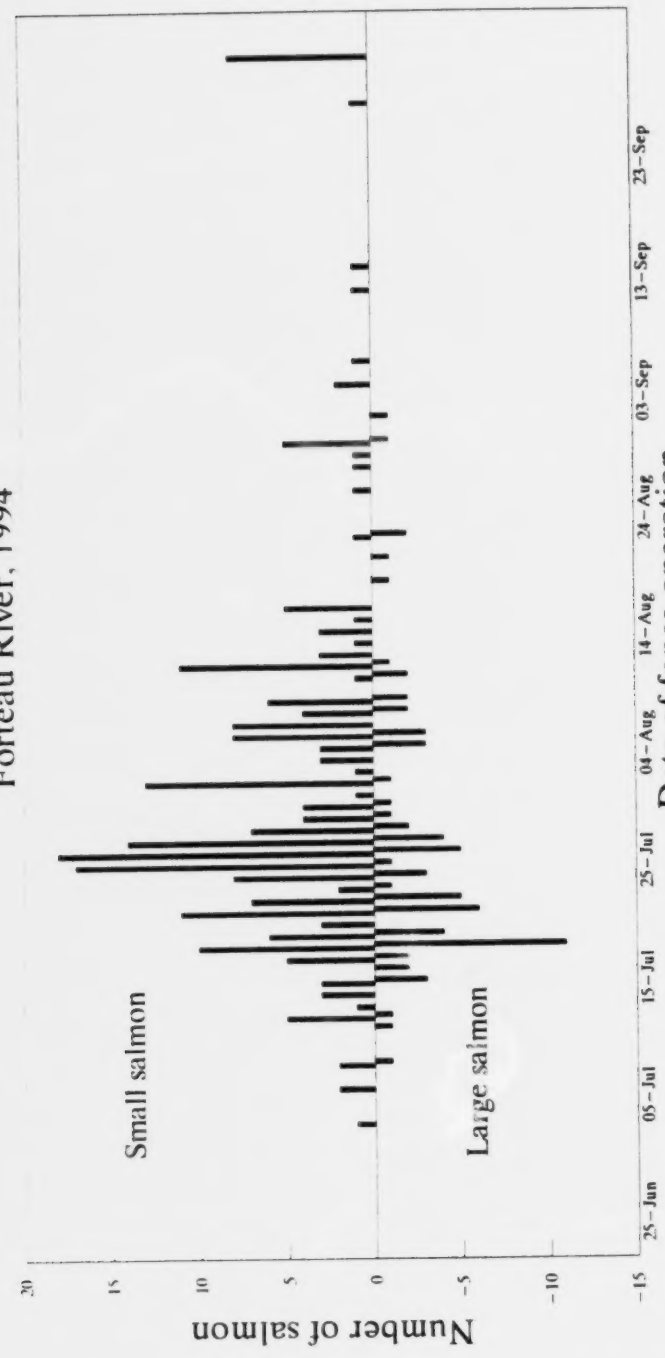

Figure 7. Daily Counts of small and large salmon at the counting fence on Forteau River, 1994.

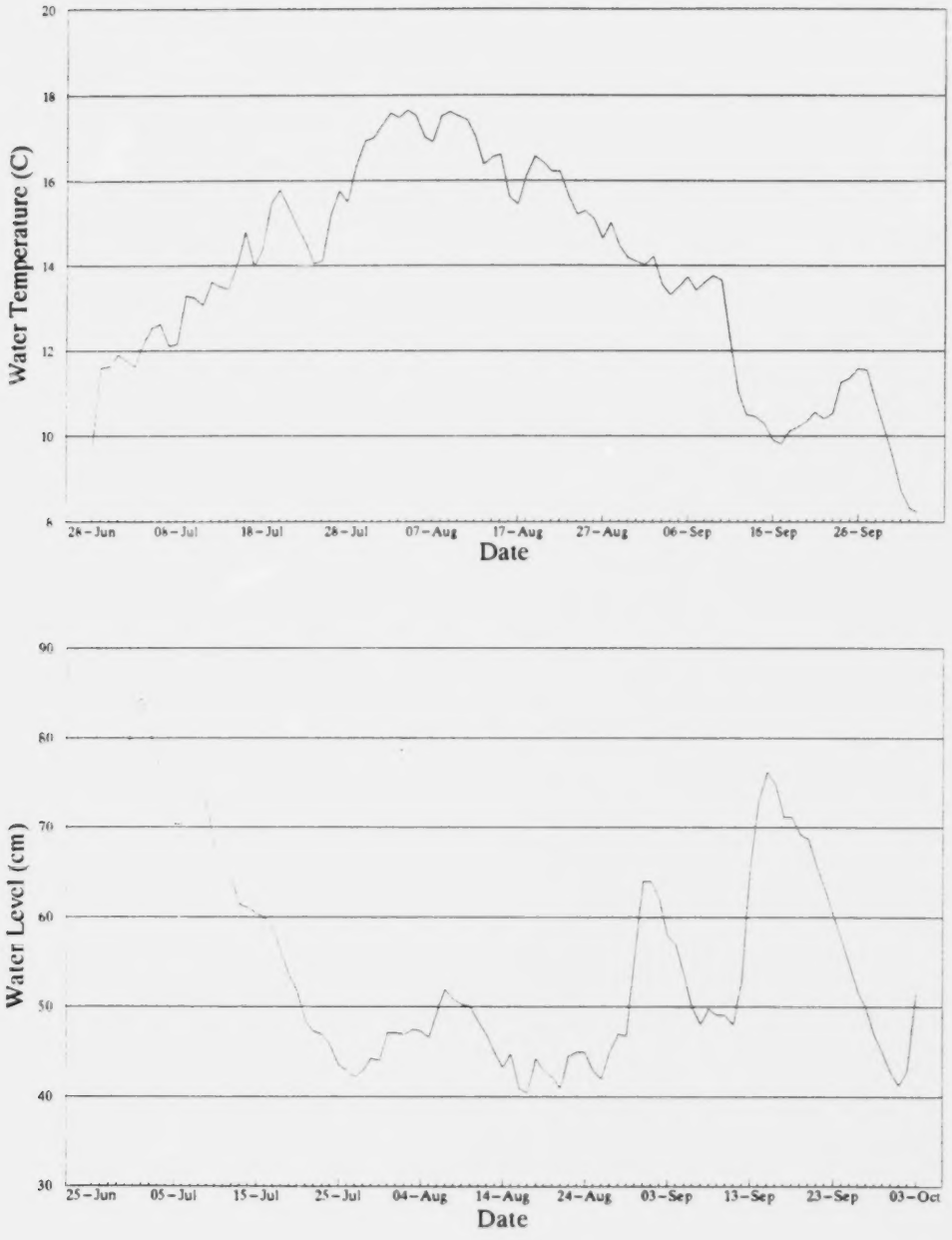

Figure 8. The water temperature (C) and water level (cm), recorded at the counting fence on the Forteau River, 1994.

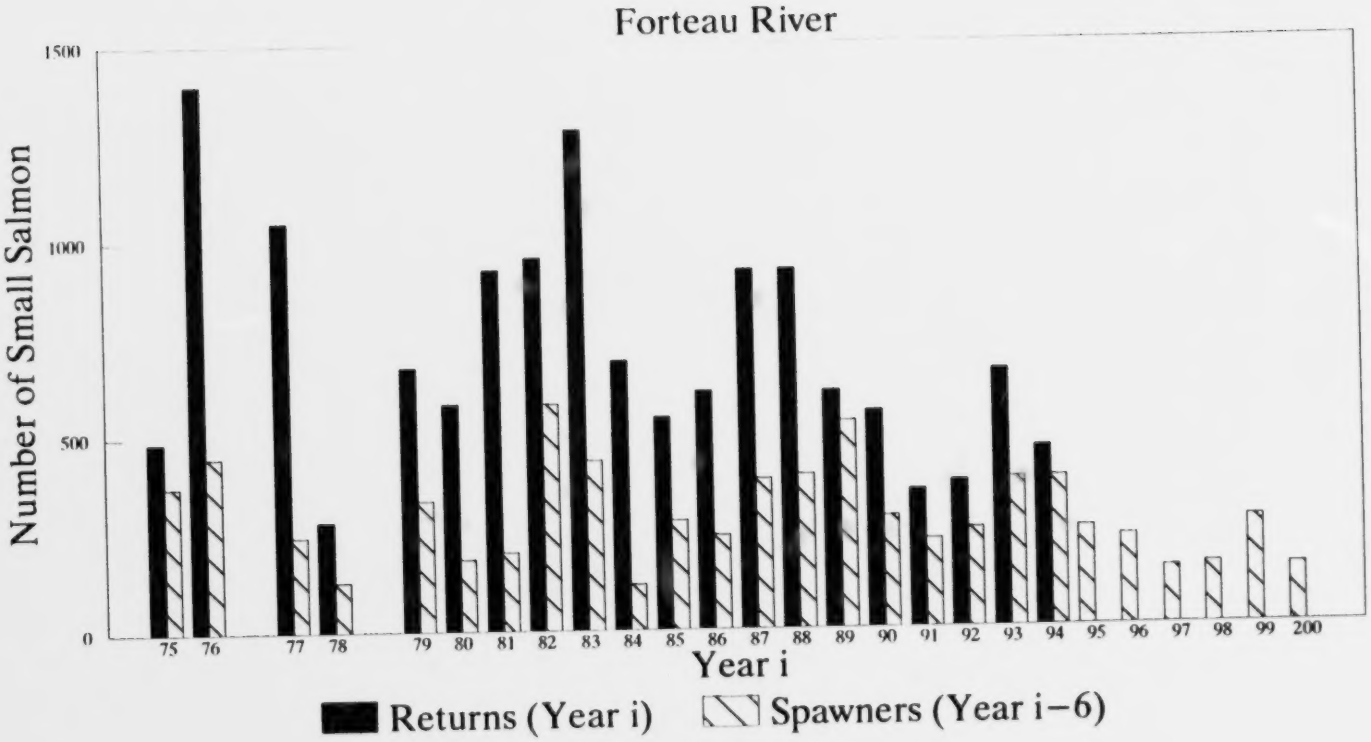

Figure 9. Estimated returns in year i and spawners in year i−6 of small salmonon the Forteau River, 1975−1994. Refer to retrospective analysis in Table 12 for actual values.

Appendix 1. The total axial length(m) of accessible tributaries and lacustine habitat(ha) in the Forteau River, as measured by SPANS GIS, from a 1:50,000 scale topographical map. Estimations of rearing habitat for target 1 and target 2 rearing units are based on widths of 1 metre and 3 metre respectively, and include those measured by Anderson (1985).

Tributary No.*	Lake Area (ha)	Axial Length (m)**	Included in 1985 survey	Axial Length (m)***	Target 1 Area (m2)****	Target 1 Units (100 m2)	Target 2 Area (m2)****	Target 2 Units (100 m2)
L-1	100							
L-2	350							
L-3	10							
L-4	60							
T-1		3,700		3,700	3,700	37	11,100	111
T-2		5,100		5,100	5,100	51	15,300	153
T-3		3,600		3,600	3,600	36	10,800	108
T-4		600		600	600	6	1,800	18
T-5		900		900	900	9	2,700	27
T-6		9,400		9,400	9,400	94	28,200	282
T-7		1,900		1,900	1,900	19	5,700	57
T-8		1,500		1,500	1,500	15	4,500	45
T-9		3,800		3,800	3,800	38	11,400	114
T-10		1,700		1,700	1,700	17	5,100	51
T-11		13,700	6,100	7,600	7,600	76	22,800	228
T-12		5,300	3,300	2,000	2,000	20	6,000	60
T-13		1,500		1,500	1,500	15	4,500	45
T-14		1,200		1,200	1,200	12	3,600	36
T-15		2,000	1,000	1,000	1,000	10	3,000	30
T-16		2,800		2,800	2,800	28	8,400	84
T-17		1,800		1,800	1,800	18	5,400	54
T-18		14,400	3,100	11,300	11,300	113	33,900	339
Total	520	74,900	13,500	61,400	61,400	614	184,200	1,842
Anderson (1985)						1,426		1,426
Total rearing units						2,040		3,268

* Tributary number corresponds to numbers on Figure 2 in this document.
** Total axial length of accessible tributaries in the Forteau River, measured by SPANS GIS.
*** Total axial length of accessible tributaries in the Forteau River, measured by SPANS GIS, excluding the area survey by Anderson (1985).
**** Area 1 based on total axial length (SPANS GIS) and estimated average widths of 1m; for Area 2 estimated average width of 3m.